

EVALUATION OF SURGICAL TREATMENT OF FRACTURES IN TWO OR THREE PARTS OF THE PROXIMAL HUMERUS WITH THE "PARACHUTE TECHNIQUE"

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ABSTRACT

Objective: To evaluate the efficacy and safety of the surgical technique called the "parachute technique", as applied to adult patients who suffered displaced and unstable two or three-part fractures of the proximal humerus, through the clinical outcomes. **Methods:** Between January 1995 and June 2006, 59 adult patients with displaced and unstable two or three-part fractures underwent operations performed by the Shoulder and Elbow Group of the Orthopedics and Traumatology Service of Hospital do Servidor Público Estadual de São Paulo using the "parachute technique". This method consists of an intramedullary tension band and extramedullary fixation in a figure-of-eight to join the fragments of the fracture, using a 6.5-millimeter spongy screw with partial threading, a washer and two non-absorbable wires, thereby producing stable synthesis with minimal aggression to

the surrounding soft tissue and not requiring any subsequent removal of material. The final shape of this synthesis is reminiscent of the shape of an open parachute. The patients had a minimum postoperative follow-up of six months. For the diagnosis, trauma series radiographic views of the shoulder were produced. The fractures were classified in accordance with the system proposed by Neer. We used the scale of the University of California, Los Angeles (UCLA), to evaluate the results. **Results:** The "parachute technique" produced good results in 47% and excellent results in 26% of the cases, according to the UCLA scores. **Conclusion:** The "parachute technique" is a safe and effective treatment for displaced and unstable two or three-part fractures of the proximal humerus.

Keywords – Shoulder; Humeral fractures/surgery; Osteosynthesis

INTRODUCTION

The incidence of fractures of the proximal humerus is estimated to be around 3% to 5% of all fractures. It is greater after the age of 50 years, and approximately 80% of these cases are in females. This type of fracture is the third most common type among elderly patients⁽¹⁴⁾.

Codman described the four basic anatomical parts of the proximal humerus: head, greater tubercle, lesser tubercle and diaphysis, taking into consideration its vascularization. The classification for fractures of the proximal humerus that is most used was described by Neer, based on the displacement between the four fragments described by Codman, with the aims of establishing the prognosis regarding humeral head viability and guiding management⁽⁵⁾.

Conservative treatment is indicated in up to 85% of the cases resulting from low-energy trauma, since these cases present little displacement between the fragments (up to 1 cm or 45°, according to the Neer criteria). Surgical treatment is reserved for cases of displaced fractures, unstable fractures or fractures with associated vasculonervous injuries⁽¹³⁾. Two and three-part fractures presenting displacement and fracture-luxations present unsatisfactory results when conservative treatment is administered, because of the difficulty in achieving reduction without using open surgery, due to interposition of adjacent soft tissues and action by the musculature of the scapular belt^(1,2,6).

A large number of surgical techniques for treating fractures of the proximal humerus have been described, and opinions are divided regarding the best fixation method,

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especially for elderly patients with osteoporosis⁽¹⁾. The techniques most used are rigid osteosynthesis with plates and screws, and tension bands with or without flexible intramedullary nails⁽²⁾. There are also minimally invasive techniques such as closed reduction and percutaneous fixation⁽³⁾. The techniques that use plates and screws confer greater stability to good-quality bones, but their efficacy diminished in porotic bones⁽¹⁾.

The aim of this study was to clinically and radiographically assess the results from using a technique that combined an intramedullary tension band with another, extramedullary tension band in a figure-of-eight shape, with a screw, washer and non-absorbable wires. This method is known as the “parachute technique”, and it was described and published previously in the *Revista Brasileira de Ortopedia*, in September 1997⁽²⁾.

METHODS

Between January 1995 and June 2006, 59 shoulders of 59 adult patients underwent operations performed by the Shoulder and Elbow Group of the Orthopedics and Traumatology Group of Hospital do Servidor Público Estadual de São Paulo, to treat two or three-part fractures of the proximal humerus in accordance with the Neer criteria, by means of the “parachute technique”.

Seven patients were excluded from this study because they were followed up for less than six months and 26 patients were excluded because they were lost from the outpatient follow-up. The patients’ ages ranged from 40 to 87 years (mean of 54 years). Female sex (72%) predominated over male sex (28%), and the dominant limb was operated in 72% of the cases. The patients were followed up for periods ranging from six to 120 months (mean of 31 months). The time that elapsed between the trauma and the surgical treatment ranged from one to 21 days (mean of five days). Falling onto the ground was the trauma mechanism responsible for 67% of the fractures (40 patients). In 19 patients, the fractures resulted from high-energy trauma (four individuals who were run over, 12 car accidents and three accidents on motorcycles).

The technique consisted of using an intramedullary tension band that was formed by two Ethibond® number 5 wires that were put around the smooth segment of the shaft of a 6.5 mm spongy screw (Figure 1), with partial threading and a washer. This screw was placed in the humeral diaphysis, distally to the focus of the fracture and perpendicularly to the intertubercular groove. After

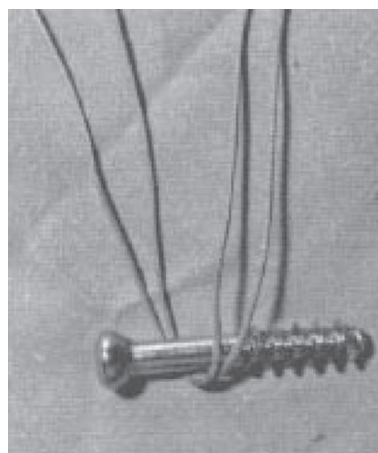


Figure 1 – Wires around the unthreaded area of the screw

blockade of the brachial plexus together with general anesthesia, the patients were put in a “deckchair” position. The classic deltopectoral access route was used (Figures 2a and b), with exposure of the focus of the

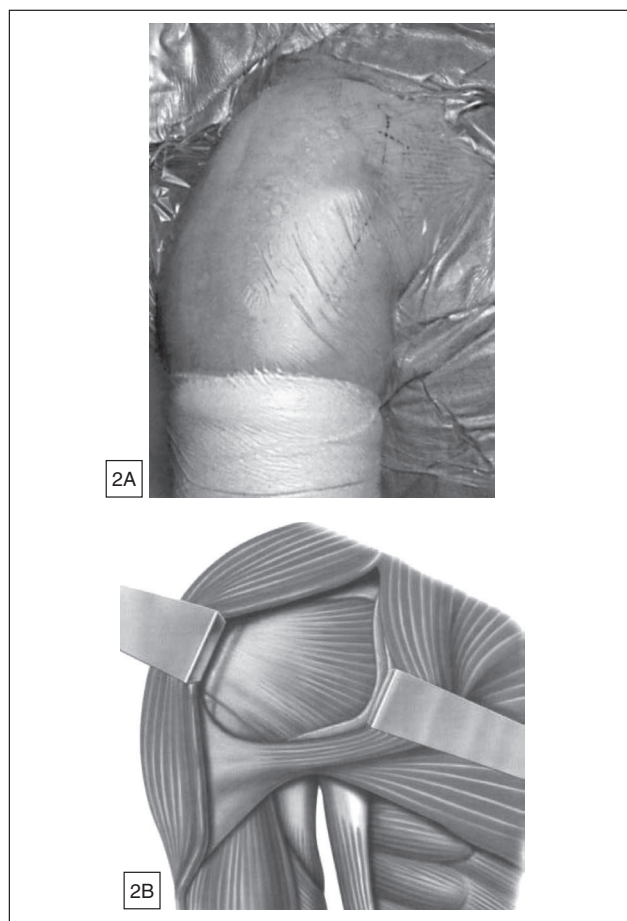


Figure 2 – A, B) Classic deltopectoral access route

fracture. The first Ethibond® wire transfixes the greater tubercle from outside to inside, coming out in the spongy part of this fragment. Next, posteriorly to the long head of the brachial biceps muscle, the wire was repaired at its midpoint, to form a loop. The lesser tubercle was transfixes from inside to outside, with the wire brought out through the rotator cuff. This procedure was repeated with the second Ethibond® wire, and the two wires needed to remain parallel and equidistant from each other. The medullary canal of the humerus was isolated and the two repaired Ethibond® loops were inserted. Next, the 6.5 mm spongy screw with partial threading and washer was transfixes in the humeral diaphysis, from laterally to medially and perpendicularly to the intertubercular groove, such that the two wire loops were wrapped around the smooth (unthreaded) part of the shaft of the screw, in order to anchor them.

Thus, the wires followed intramedullary paths in diverging, ascending directions to the greater and lesser tubercles, thereby forming a structure reminiscent of an open parachute. With the two Ethibond® wires, there were four ends: two medial ends at the lesser tubercle and two lateral ends at the greater tubercle (Figure 3).

Next, the fracture was reduced and the four ends of the wires were tensioned. The ends at the lesser tubercle were firstly tied to each other, and then the ends at the greater tubercle, over the rotator cuff. There were thus two pairs of double wires, one on each tubercle. The wires were then crossed under the tendon of the long head of the brachial biceps muscle, tensioned and tied under the washer of the screw that had earlier been placed in the humeral diaphysis, thereby forming a figure-of-eight (Figures 4a, b, c and d).

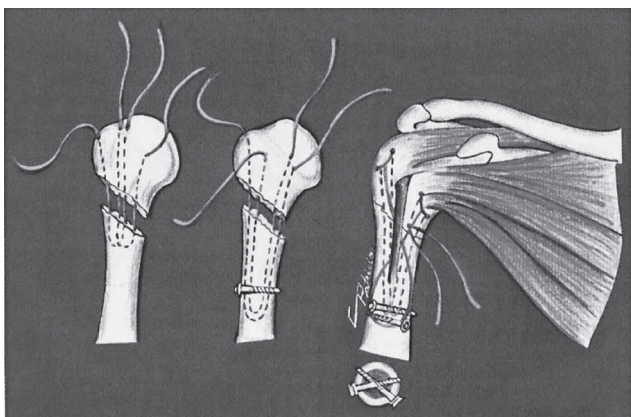


Figure 3 – “Parachute technique”, which combines one intramedullary tension band with another, extramedullary tension band in a figure-of-eight

Impaction and stabilization of the fragments was thus achieved by means of this double fixation: one intramedullary, resembling an open parachute, and the other, extramedullary, in a figure-of-eight (Figures 5a and b).

The postoperative protocol was divided into three phases. The first phase began on the first postoperative day and consisted of a program of movements using the elbow, wrist and hand. The second phase was between the third and sixth weeks after the operation and consisted of pendular Codman movements, passive elevation of up to 90° and passive rotation of up to 20°. The third phase consisted of physiotherapy to gain passive and active range of motion, followed by an exercise program for muscle strengthening, against resistance, which began between the sixth and eighth weeks after the operation, after achieving clinical and radiographic consolidation of the fracture.

The clinical evaluation of our results was performed using the scoring system defined by the University of California at Los Angeles (UCLA)⁽⁷⁾, as modified by Ellman and Kay⁽⁷⁾. This is based on objective and subjective criteria and attributes scores to the parameters of pain, degree of mobility, shoulder function, strength and patient satisfaction. The maximum score is 35 points. To measure the degree of range of joint motion, we used the method described by the American Academy of Orthopedic Surgeons.

RESULTS

Fifty-nine patients were available for evaluating the “parachute technique”. According to the UCLA scoring system⁽⁷⁾, 28 patients (47%) scored 35 points and were classified as presenting excellent results; 15 patients (26%), with 33 points, as good; nine patients (15%), with 29 points, as moderate; and seven patients (12%), with 27 points, as poor.

After completing the three phases of the rehabilitation protocol, the active elevation ranged from 60° to 180° (mean of 160°); the lateral rotation ranged from 5° to 75° (mean of 60°) and the medial rotation ranged from thumb-gluteus to thumb-T8 (mean of T12).

Complications were found in six patients: one with pseudarthrosis, three with loss of reduction, one with adhesive capsulitis and one with infection. There were no cases of osteonecrosis in the later assessments on the patients.

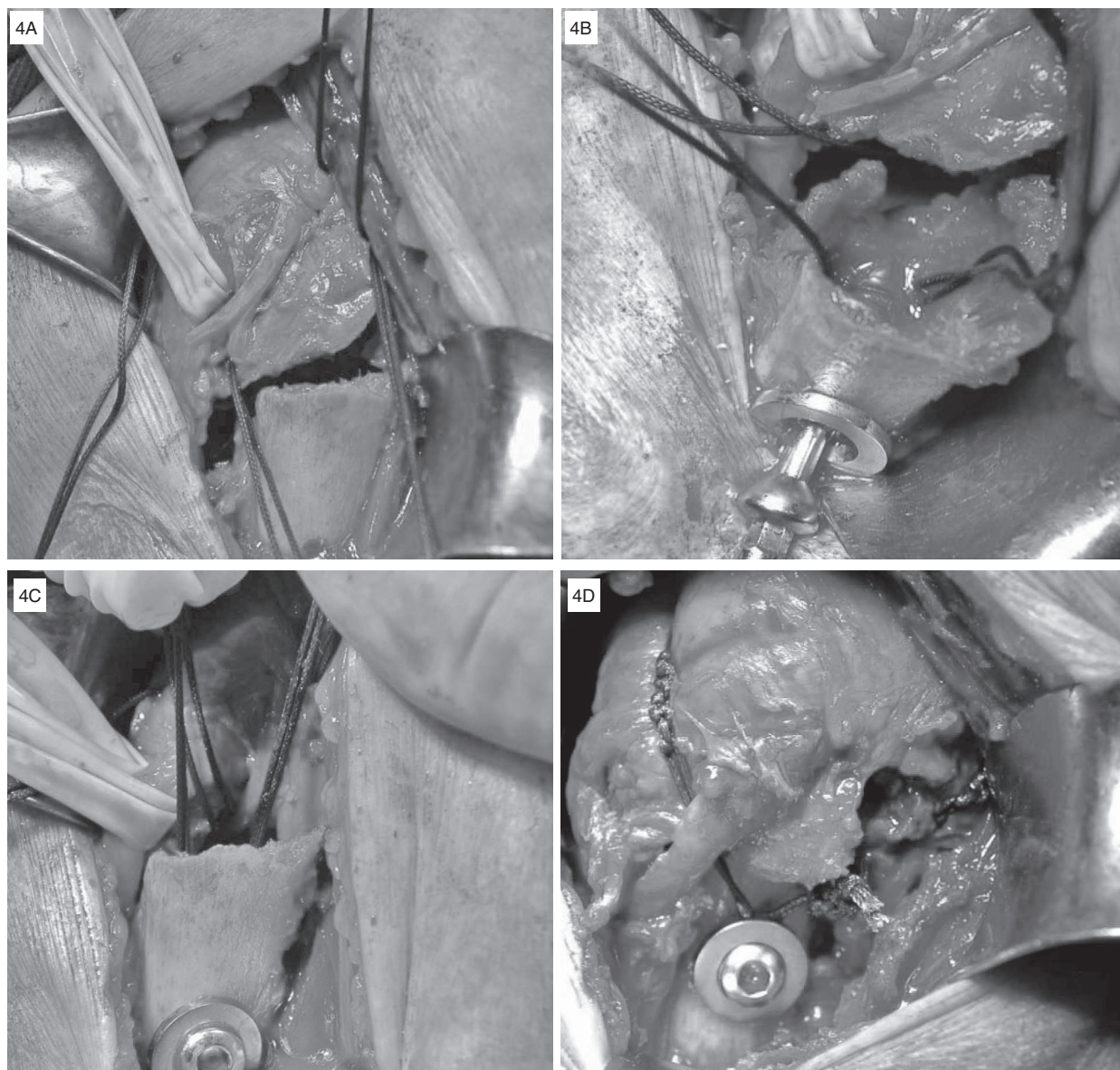


Figure 4 – Operative technique: A) Transfixation of the tubercles with the wire, thus forming a loop; B) Insertion of loop into the medullary canal and placement of screw; C) The wires are tensioned and the fracture is reduced; D) The wires are tied to each other and posteriorly under the washer of the screw, thus forming a figure-of-eight

DISCUSSION

Muscle action on the proximal humerus, thereby producing displacements, and interposition of soft tissue at the focus of the fracture, make it difficult to achieve and maintain the reductions of the displaced fractures. In these cases, open reduction and rigid fixation, thereby enabling early mobilization, produce better results than does closed treatment^(4,6).

There is no consensus in the literature regarding the best method of surgical treatment for displaced two or three-part fractures of the proximal humerus, and expe-

rience gained with a given technique used by one group may not be reproducible in other centers. Grouping of different types of fractures into the same study makes comparisons between the methods difficult, both because of imperfections in the classification systems and because of difficulty regarding intra and inter-observer reproducibility. The influence of the patient's age on the treatment results is also an important factor to be considered, given that not only osteoporosis but also rotator cuff injuries are common among the elderly. However, regardless of the method used, the best re-

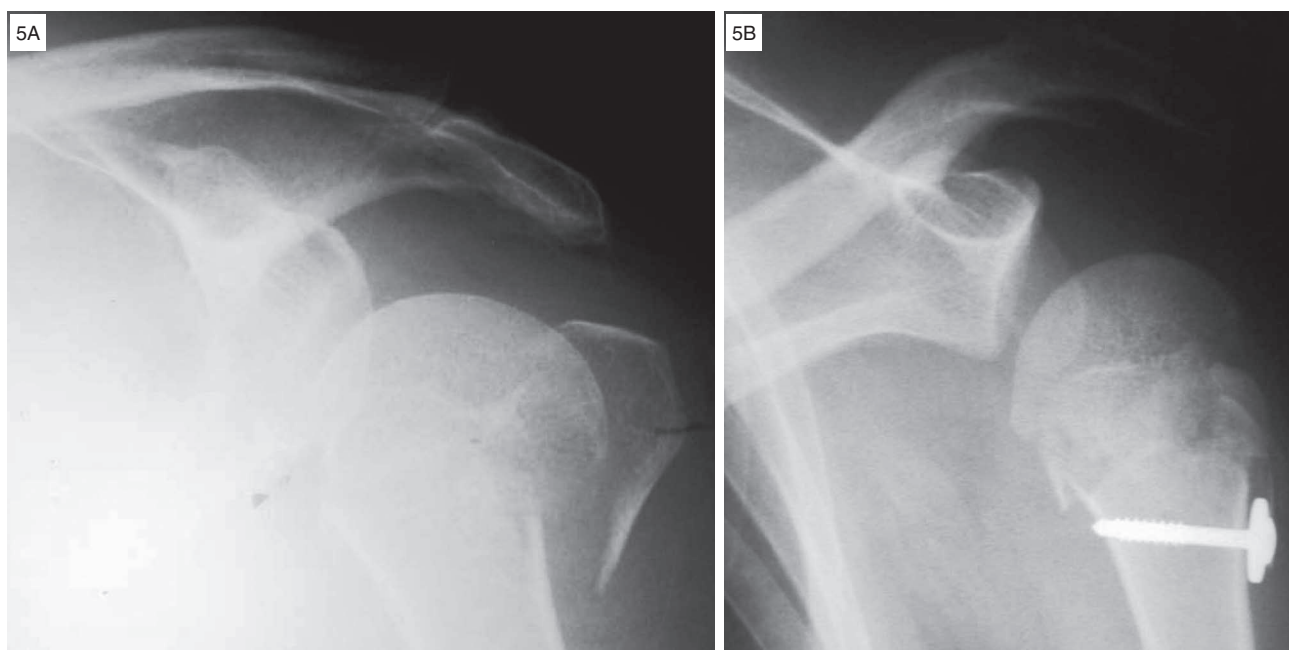


Figure 5 – A) Anteroposterior radiograph showing three-part fracture of the proximal humerus. B) Radiograph of the same fracture, in true anteroposterior position immediately after the operation using the “parachute technique”

sults are when reduction with anatomical restoration and stability are achieved^(4,8,9).

Percutaneous fixation of fractures of the proximal humerus presents the advantage of minimal aggression against the adjacent soft tissues, although this technique is not exempt from complications such as injuries to the axillary and radial nerves. It also has the disadvantage of providing lower resistance to angular displacement^(4,6).

The use of tension bands in association with intramedullary flexible nails provides good stability for the synthesis, including in patients with porotic bones, with minimal aggression against adjacent soft tissues. However, they violate the rotator cuff and present complications such as proximal migration of the nails, thereby producing subacromial impact syndrome and requiring a second surgical procedure to remove the synthesis material⁽⁶⁾.

The use of plates and screws enables good fixation in strong bones, but loosening of the synthesis material occurs frequently in porotic bones because the screws do not have enough grip. Moreover, there is the possibility that subacromial impact syndrome might be caused by migration of the screws, along with avascular necrosis due to excessive removal of periosteum and aggression against the adjacent soft tissue^(1,4,5,8,10).

New techniques have been introduced with the aim of restoring the anatomy, such as Polarus nail, Plan Tan

Humerus Fixator Plate and Proximal humerus internal locked system (PHILOS). These are not exempt from the same complications as listed above; their cost is high and there are still few studies in the literature, with insufficient samples and follow-up for comparative studies between the treatment methods^(4,10). Among this new generation of synthesis material, the fixed-angle PHILOS plate has shown the best results in fragile bones, because of better anchorage of the locking screws in the bone^(4,10).

The “parachute technique” has been shown to be a good alternative insofar as it confers stability to the synthesis, even in porotic bones. It makes use of the rotator cuff as an auxiliary element in stabilizing the fragments, with minimal use of synthesis, low cost and minimal aggression against adjacent soft tissues. It thus enables early mobilization and favors patient rehabilitation (Figures 6a, b, c and d). The impaction achieved confers the stability needed, and this is tested during the operation. The technique does not violate the rotator cuff and does not interfere with the biomechanics of the shoulder. It does not require radioscopy, does not have any subacromial impact and does not require removal of the synthesis material⁽²⁾. It has been shown to be a reproducible technique, with high rates of excellent and good results and low rates of complications, after 10 years of follow-up.

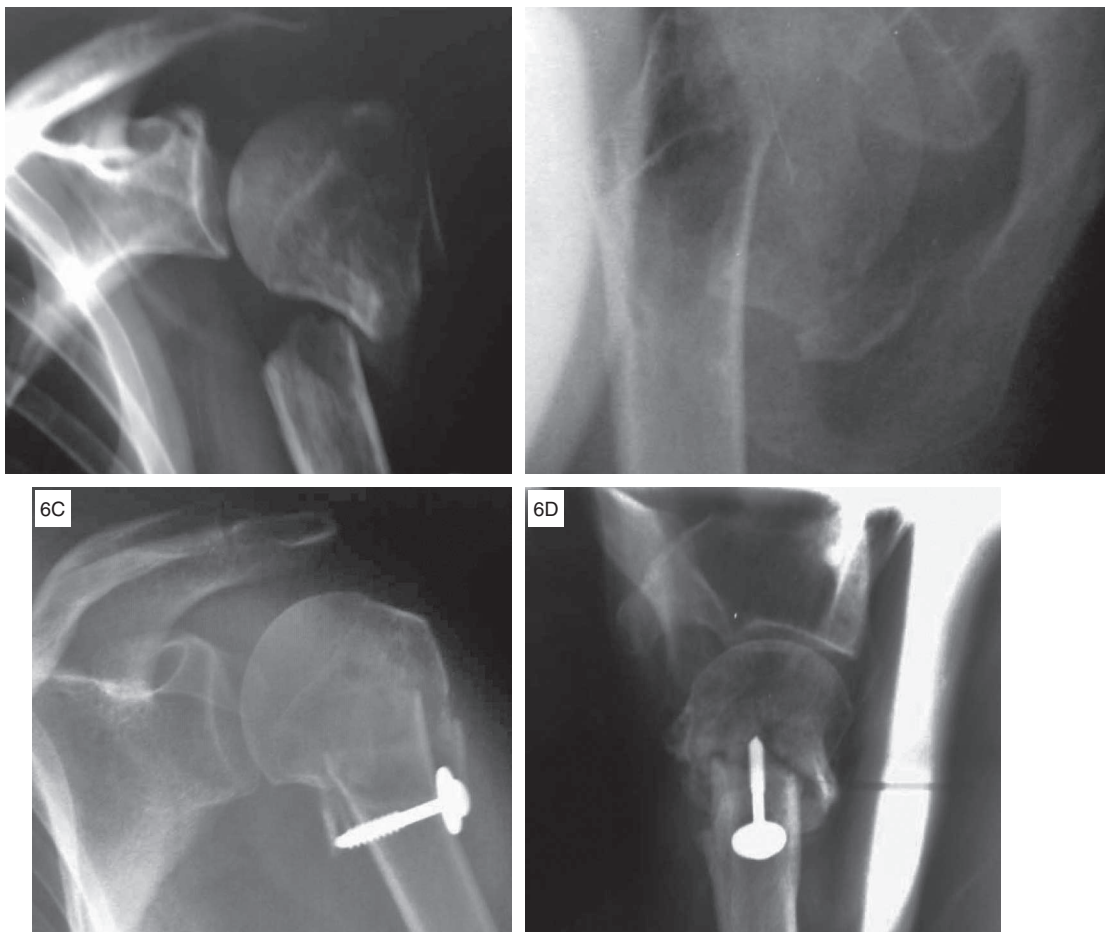


Figure 6 – Radiographs in true anteroposterior position C) and axillary position D) in the immediate postoperative period using the “parachute technique”

CONCLUSIONS

According to the results obtained, we conclude that the “parachute technique” is safe and effective for surgi-

cal treatment of displaced and unstable two or three-part fractures of the proximal humerus. It provided good and excellent results for 73% of the patients evaluated, which allows us to regard it as a good treatment option.

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